

CLAIMS

1. An optical packet exchanger for switching a transmission path for an optical packet which constitutes a burst-type optical signal, comprising:

an optical transmitter section for transmitting an optical packet, on which an information signal and an address signal corresponding to a transmission destination for the information signal are superposed by different modulation methods;

an optical transmission section for propagating an optical packet transmitted from the optical transmitter section; and

a router section for receiving the optical packet via the optical transmission section, and switching a transmission path for the optical packet based on the address signal which is extracted from the optical packet.

2. The optical packet exchanger according to claim 1, wherein,

the optical transmitter section includes:

a light source for outputting continuous light; and
an optical modulation section for outputting an optical packet which is obtained by subjecting the output light from the light source to an intensity modulation using the information signal and a phase modulation using the address signal,

the router section includes:

an optical splitter section for splitting the optical packet received via the optical transmission section into two optical packets;

an address reading section for reading the address
5 signal based on phase information of one of the optical packets output from the optical splitter section; and

a path switching section having a plurality of output ports and selecting, based on the address signal read by the address reading section, one of the plurality of output ports from which
10 to output the other optical packet output from the optical splitter section.

3. The optical packet exchanger according to claim 1, wherein,

15 the optical transmitter section includes:

a light signal source for outputting continuous light having been subjected to an intensity modulation using the information signal; and

an optical modulation section for outputting an
20 optical packet which is obtained by subjecting the output light from the light signal source to a phase modulation using the address signal, and

the router section includes:

an optical splitter section for splitting the optical
25 packet received via the optical transmission section into two

optical packets;

an address reading section for reading the address signal based on phase information of one of the optical packets output from the optical splitter section; and

5 a path switching section having a plurality of output ports and selecting, based on the address signal read by the address reading section, one of the plurality of output ports from which to output the other optical packet output from the optical splitter section.

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4. The optical packet exchanger according to claim 1, wherein,

the optical transmitter section includes:

15 a light signal source for outputting continuous light having been subjected to a phase modulation using the address signal; and

20 an optical modulation section for outputting an optical packet which is obtained by subjecting the output light from the light signal source to an intensity modulation using the information signal, and

the router section includes:

an optical splitter section for splitting the optical packet received via the optical transmission section into two optical packets;

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an address reading section for reading the address

signal based on phase information of one of the optical packets output from the optical splitter section; and

5 a path switching section having a plurality of output ports and selecting, based on the address signal read by the address reading section, one of the plurality of output ports from which to output the other optical packet output from the optical splitter section.

10 5. The optical packet exchanger according to claim 1, wherein,

the optical transmitter section includes:

a light source for outputting continuous light; and
an optical modulation section for outputting an optical packet which is obtained by subjecting the output light
15 from the light source to an intensity modulation using the information signal and a phase modulation using the address signal, and

the router section includes:

20 an optical splitter section for splitting the optical packet received via the optical transmission section into two optical packets;

an address reading section for reading the address signal based on phase information of one of the optical packets output from the optical splitter section;

25 an optical phase adjustment section for adjusting a

phase of the other optical packet output from the optical splitter section to a constant phase value, based on the address signal read by the address reading section; and

5 a path switching section having a plurality of output ports and selecting, based on the address signal read by the address reading section, one of the plurality of output ports from which to output the other optical packet whose phase has been adjusted to the constant phase value by the optical phase adjustment section.

10 6. The optical packet exchanger according to claim 1, wherein,

the optical transmitter section includes:

15 a light signal source for outputting continuous light having been subjected to an intensity modulation using the information signal; and

an optical modulation section for outputting an optical packet which is obtained by subjecting the output light from the light signal source to a phase modulation using the address signal, and

20 the router section includes:

an optical splitter section for splitting the optical packet received via the optical transmission section into two optical packets;

25 an address reading section for reading the address signal based on phase information of one of the optical packets

output from the optical splitter section;

an optical phase adjustment section for adjusting a phase of the other optical packet output from the optical splitter section to a constant phase value, based on the address signal
5 read by the address reading section; and

a path switching section having a plurality of output ports and selecting, based on the address signal read by the address reading section, one of the plurality of output ports from which to output the other optical packet whose phase has been adjusted
10 to the constant phase value by the optical phase adjustment section.

7. The optical packet exchanger according to claim 1, wherein,

the optical transmitter section includes:

15 a light signal source for outputting continuous light having been subjected to a phase modulation using the address signal; and

an optical modulation section for outputting an optical packet which is obtained by subjecting the output light
20 from the light signal source to an intensity modulation using the information signal, and

the router section includes:

an optical splitter section for splitting the optical packet received via the optical transmission section into two
25 optical packets;

an address reading section for reading the address signal based on phase information of one of the optical packets output from the optical splitter section;

an optical phase adjustment section for adjusting a
5 phase of the other optical packet output from the optical splitter section to a constant phase value, based on the address signal read by the address reading section; and

a path switching section having a plurality of output ports and selecting, based on the address signal read by the address
10 reading section, one of the plurality of output ports from which to output the other optical packet whose phase has been adjusted to the constant phase value by the optical phase adjustment section.

8. The optical packet exchanger according to claim 2,
15 wherein,

the optical modulation section comprises:

an optical splitter section for splitting the output light from the light source into two light portions;

a first splitter section for splitting the address signal
20 into two address signals;

a second splitter section for splitting the information signal into two information signals;

a phase inversion section for inverting a phase of one of the information signals output from the second splitter section;

25 a first synthesis section for combining one of the address

signals output from the first splitter section with the information signal whose phase has been inverted by the phase inversion section, to output a first synthesized signal;

5 a second synthesis section for combining the other address signal output from the first splitter section with the other information signal output from the second splitter section, to output a second synthesized signal;

10 a first waveguide for subjecting one of the light portions output from the optical splitter section to a phase modulation using the first synthesized signal;

a second waveguide for subjecting the other light portion output from the optical splitter section to a phase modulation using the second synthesized signal; and

15 an optical synthesis section for permitting optical synthesis and interference between the optical phase modulated signal output from the first waveguide and the optical phase modulated signal output from the second waveguide to generate the optical packet.

20 9. The optical packet exchanger according to claim 5, wherein,

the optical modulation section comprises:

an optical splitter section for splitting the output light from the light source into two light portions;

25 a first splitter section for splitting the address signal

into two address signals;

a second splitter section for splitting the information signal into two information signals;

a phase inversion section for inverting a phase of one of
5 the information signals output from the second splitter section;

a first synthesis section for combining one of the address signals output from the first splitter section with the information signal whose phase has been inverted by the phase inversion section, to output a first synthesized signal;

10 a second synthesis section for combining the other address signal output from the first splitter section with the other information signal output from the second splitter section, to output a second synthesized signal;

a first waveguide for subjecting one of the light portions
15 output from the optical splitter section to a phase modulation using the first synthesized signal;

a second waveguide for subjecting the other light portion output from the optical splitter section to a phase modulation using the second synthesized signal; and

20 an optical synthesis section for permitting optical synthesis and interference between the optical phase modulated signal output from the first waveguide and the optical phase modulated signal output from the second waveguide to generate the optical packet.

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10. The optical packet exchanger according to claim 1,
wherein,

a modulation speed for the address signal and a modulation
speed for the information signal are different.

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11. The optical packet exchanger according to claim 2,
wherein,

the address reading section includes:

a phase/intensity conversion section for outputting an
10 optical signal which is obtained by converting optical phase
variation in one of the optical packets output from the optical
splitter section into optical intensity variation; and

a photoelectric conversion section for converting the
optical signal output from the phase/intensity conversion section
15 into an address signal.

12. The optical packet exchanger according to claim 3,
wherein,

the address reading section includes:

20 a phase/intensity conversion section for outputting an
optical signal which is obtained by converting optical phase
variation in one of the optical packets output from the optical
splitter section into optical intensity variation; and .

a photoelectric conversion section for converting the
25 optical signal output from the phase/intensity conversion section

into an address signal.

13. The optical packet exchanger according to claim 4, wherein,

5 the address reading section includes:

a phase/intensity conversion section for outputting an optical signal which is obtained by converting optical phase variation in one of the optical packets output from the optical splitter section into optical intensity variation; and

10 a photoelectric conversion section for converting the optical signal output from the phase/intensity conversion section into an address signal.

14. The optical packet exchanger according to claim 5, wherein,

the address reading section includes:

20 a phase/intensity conversion section for outputting an optical signal which is obtained by converting optical phase variation in one of the optical packets output from the optical splitter section into optical intensity variation; and

a photoelectric conversion section for converting the optical signal output from the phase/intensity conversion section into positive and negative address signals, the negative address signal being obtained by inverting the polarity of the positive address signal, and outputting the positive address signal to the

path switching section and the negative address signal to the optical phase adjustment section.

15. The optical packet exchanger according to claim 6,
5 wherein,

the address reading section includes:

a phase/intensity conversion section for outputting an optical signal which is obtained by converting optical phase variation in one of the optical packets output from the optical
10 splitter section into optical intensity variation; and

a photoelectric conversion section for converting the optical signal output from the phase/intensity conversion section into positive and negative address signals, the negative address signal being obtained by inverting the polarity of the positive
15 address signal, and outputting the positive address signal to the path switching section and the negative address signal to the optical phase adjustment section.

16. The optical packet exchanger according to claim 7,
20 wherein,

the address reading section includes:

a phase/intensity conversion section for outputting an optical signal which is obtained by converting optical phase variation in one of the optical packets output from the optical
25 splitter section into optical intensity variation; and

a photoelectric conversion section for converting the optical signal output from the phase/intensity conversion section into positive and negative address signals, the negative address signal being obtained by inverting the polarity of the positive address signal, and outputting the positive address signal to the path switching section and the negative address signal to the optical phase adjustment section.

17. The optical packet exchanger according to claim 5,
wherein,

the address reading section includes:

a phase/intensity conversion section for outputting positive and negative optical signals, the positive optical signal being obtained by converting optical phase variation in one of the optical packets output from the optical splitter section into optical intensity variation, and the negative optical signal being obtained by inverting the polarity of the positive optical signal;

a first photoelectric conversion section for converting the positive optical signal output from the phase/intensity conversion section into an address signal and outputting the address signal to the path switching section; and

a second photoelectric conversion section for converting the negative optical signal output from the phase/intensity conversion section into an address signal, and outputting the address signal to the optical phase adjustment section.

18. The optical packet exchanger according to claim 6,
wherein,

the address reading section includes:

5 a phase/intensity conversion section for outputting
positive and negative optical signals, the positive optical signal
being obtained by converting optical phase variation in one of
the optical packets output from the optical splitter section into
optical intensity variation, and the negative optical signal being
10 obtained by inverting the polarity of the positive optical signal;

 a first photoelectric conversion section for converting the
positive optical signal output from the phase/intensity conversion
section into an address signal and outputting the address signal
to the path switching section; and

15 a second photoelectric conversion section for converting
the negative optical signal output from the phase/intensity
conversion section into an address signal, and outputting the
address signal to the optical phase adjustment section.

20 19. The optical packet exchanger according to claim 7,
wherein,

the address reading section includes:

 a phase/intensity conversion section for outputting
positive and negative optical signals, the positive optical signal
25 being obtained by converting optical phase variation in one of

the optical packets output from the optical splitter section into optical intensity variation, and the negative optical signal being obtained by inverting the polarity of the positive optical signal;

a first photoelectric conversion section for converting the
5 positive optical signal output from the phase/intensity conversion section into an address signal and outputting the address signal to the path switching section; and

a second photoelectric conversion section for converting
the negative optical signal output from the phase/intensity
10 conversion section into an address signal, and outputting the address signal to the optical phase adjustment section.

20. The optical packet exchanger according to claim 11,
wherein,

15 the photoelectric conversion section converts an intensity of the optical signal output from the phase/intensity conversion section to logic value 1 if the intensity is equal to or less than a predetermined threshold value and to logic value 0 if the intensity is greater than the predetermined threshold value, thereby
20 extracting the address signal.

21. The optical packet exchanger according to claim 14,
wherein,

the photoelectric conversion section converts an intensity
25 of the optical signal output from the phase/intensity conversion

section to logic value 1 if the intensity is equal to or less than a predetermined threshold value and to logic value 0 if the intensity is greater than the predetermined threshold value, thereby extracting the address signal.

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22. The optical packet exchanger according to claim 17, wherein,

the photoelectric conversion section converts an intensity of the optical signal output from the phase/intensity conversion
10 section to logic value 1 if the intensity is equal to or less than a predetermined threshold value and to logic value 0 if the intensity is greater than the predetermined threshold value, thereby extracting the address signal.

15 23. The optical packet exchanger according to claim 20, wherein,

the threshold value is equal to or greater than a value which is $1/4$ as large as a difference between an optical intensity of the optical packet input to the optical splitter section at logic
20 value 1 and an optical intensity of the optical packet at logic value 0, and is equal to or less than a value which is $1/2$ as large as the optical intensity of the optical packet at logic value 0.

24. The optical packet exchanger according to claim 21,
25 wherein,

the threshold value is equal to or greater than a value which is $1/4$ as large as a difference between an optical intensity of the optical packet input to the optical splitter section at logic value 1 and an optical intensity of the optical packet at logic value 0, and is equal to or less than a value which is $1/2$ as large as the optical intensity of the optical packet at logic value 0.

25. The optical packet exchanger according to claim 22, wherein,

10 the threshold value is equal to or greater than a value which is $1/4$ as large as a difference between an optical intensity of the optical packet input to the optical splitter section at logic value 1 and an optical intensity of the optical packet at logic value 0, and is equal to or less than a value which is $1/2$ as large
15 as the optical intensity of the optical packet at logic value 0.

26. The optical packet exchanger according to claim 11, wherein,

the phase/intensity conversion section comprises a
20 Mach-Zehnder interferometer.

27. The optical packet exchanger according to claim 14, wherein,

the phase/intensity conversion section comprises a
25 Mach-Zehnder interferometer

28. The optical packet exchanger according to claim 17,
wherein,

the phase/intensity conversion section comprises a
5 Mach-Zehnder interferometer.

29. The optical packet exchanger according to claim 11,
wherein,

the phase/intensity conversion section outputs two optical
10 signals whose modulated components are out of phase.

30. The optical packet exchanger according to claim 29,
wherein,

the photoelectric conversion section comprises two
15 photodiodes for respectively detecting the two optical signals
output from the phase/intensity conversion section.

31. The optical packet exchanger according to claim 1,
wherein,

20 the optical transmitter section includes:

a light source for outputting continuous light; and
an optical modulation section for outputting an
optical packet which is obtained by subjecting the output light
from the light source to a phase modulation using the information
25 signal and an intensity modulation using the address signal, and

the router section includes:

an optical splitter section for splitting the optical packet received via the optical transmission section into two optical packets;

5 an address reading section for reading the address signal from intensity information of one of the optical packets output from the optical splitter section; and

a path switching section having a plurality of output ports and selecting, based on the address signal read by the address
10 reading section, one of the plurality of output ports from which to output the other optical packet output from the optical splitter section.

32. The optical packet exchanger according to claim 1,
15 wherein,

the optical transmitter section includes:

a light source for outputting continuous light; and

an optical modulation section for outputting an optical packet which is obtained by subjecting the output light
20 from the light source to a phase modulation using the information signal and an intensity modulation using the address signal, and

the router section includes:

an optical splitter section for splitting the optical packet received via the optical transmission section into two
25 optical packets;

an address reading section for reading the address signal from intensity information of one of the optical packets output from the optical splitter section;

an optical intensity adjustment section for adjusting
5 an intensity of the other optical packet output from the optical splitter section to a constant intensity value, based on the address signal read by the address reading section; and

a path switching section having a plurality of output ports and selecting, based on the address signal read by the address
10 reading section, one of the plurality of output ports from which to output the other optical packet whose intensity has been adjusted to the constant intensity value by the optical intensity adjustment section.

15 33. A router for switching a transmission path for an optical packet which constitutes a burst-type optical signal and on which an information signal and an address signal corresponding to a transmission destination for the information signal are superposed by different modulation methods, the router comprising:

20 an optical splitter section for splitting the optical packet into two optical packets;

an address reading section for reading the address signal based on phase information of one of the optical packets output from the optical splitter section; and

25 a path switching section having a plurality of output ports

and selecting, based on the address signal read by the address reading section, one of the plurality of output ports from which to output the other optical packet output from the optical splitter section.

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34. The router according to claim 33, further comprising an optical phase adjustment section for adjusting a phase of the other optical packet output from the optical splitter section to a constant phase value based on the address signal read by the address reading section, and thereafter outputting the other optical packet to the path switching section.

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35. The router according to claim 33, wherein,
the address reading section includes:

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a phase/intensity conversion section for outputting an optical signal which is obtained by converting optical phase variation in one of the optical packets output from the optical splitter section into optical intensity variation; and

a photoelectric conversion section for converting the optical signal output from the phase/intensity conversion section into an address signal.

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36. The router according to claim 34, wherein,
the address reading section includes:

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a phase/intensity conversion section for outputting an

optical signal which is obtained by converting optical phase variation in one of the optical packets output from the optical splitter section into optical intensity variation; and

5 a photoelectric conversion section for converting the optical signal output from the phase/intensity conversion section into positive and negative address signals, the negative address signal being obtained by inverting the polarity of the positive address signal, and outputting the positive address signal to the path switching section and the negative address signal to the
10 optical phase adjustment section.

37. The router according to claim 34, wherein,
the address reading section includes:

15 a phase/intensity conversion section for outputting positive and negative optical signals, the positive optical signal being obtained by converting optical phase variation in one of the optical packets output from the optical splitter section into optical intensity variation, and the negative optical signal being obtained by inverting the polarity of the positive optical signal;

20 a first photoelectric conversion section for converting the positive optical signal output from the phase/intensity conversion section into an address signal and outputting the address signal to the path switching section; and

25 a second photoelectric conversion section for converting the negative optical signal output from the phase/intensity

conversion section into an address signal, and outputting the address signal to the optical phase adjustment section.

38. The router according to claim 35, wherein,

5 the photoelectric conversion section converts an intensity of the optical signal output from the phase/intensity conversion section to logic value 1 if the intensity is equal to or less than a predetermined threshold value and to logic value 0 if the intensity is greater than the predetermined threshold value, thereby
10 extracting the address signal.

39. The router according to claim 36, wherein,

the photoelectric conversion section converts an intensity of the optical signal output from the phase/intensity conversion
15 section to logic value 1 if the intensity is equal to or less than a predetermined threshold value and to logic value 0 if the intensity is greater than the predetermined threshold value, thereby extracting the address signal.

20 40. The router according to claim 37, wherein,

the photoelectric conversion section converts an intensity of the optical signal output from the phase/intensity conversion section to logic value 1 if the intensity is equal to or less than a predetermined threshold value and to logic value 0 if the intensity
25 is greater than the predetermined threshold value, thereby

extracting the address signal.

41. The router according to claim 38, wherein,
the threshold value is equal to or greater than a value which
5 is $1/4$ as large as a difference between an optical intensity of
the optical packet input to the optical splitter section at logic
value 1 and an optical intensity of the optical packet at logic
value 0, and is equal to or less than a value which is $1/2$ as large
as the optical intensity of the optical packet at logic value 0.
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42. The router according to claim 39, wherein,
the threshold value is equal to or greater than a value which
is $1/4$ as large as a difference between an optical intensity of
the optical packet input to the optical splitter section at logic
15 value 1 and an optical intensity of the optical packet at logic
value 0, and is equal to or less than a value which is $1/2$ as large
as the optical intensity of the optical packet at logic value 0.

43. The router according to claim 40, wherein,
20 the threshold value is equal to or greater than a value which
is $1/4$ as large as a difference between an optical intensity of
the optical packet input to the optical splitter section at logic
value 1 and an optical intensity of the optical packet at logic
value 0, and is equal to or less than a value which is $1/2$ as large
25 as the optical intensity of the optical packet at logic value 0.

44. The router according to claim 35, wherein,
the phase/intensity conversion section comprises a
Mach-Zehnder interferometer.

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45. The router according to claim 36, wherein,
the phase/intensity conversion section comprises a
Mach-Zehnder interferometer.

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46. The router according to claim 37, wherein,
the phase/intensity conversion section comprises a
Mach-Zehnder interferometer.

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47. The router according to claim 35, wherein,
the phase/intensity conversion section outputs two optical
signals whose modulated components are out of phase.

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48. The router according to claim 47, wherein,
the photoelectric conversion section comprises two
photodiodes for respectively detecting the two optical signals
output from the phase/intensity conversion section.